Amendments to the Claims:

This listing of claims replaces all prior versions of the claims in the patent application:

1. (Currently amended) A method of interpolating image positions in an original image to produce an interpolated output image, wherein the original image is represented by digital input pixel data, comprising the steps of:

(a)   providing a first filter having a sharp interpolation characteristic;

(b)   providing a second filter having a smooth interpolation characteristic;

(c)   interpolating a selected image position in the image using the first filter to generate a sharp interpolation output value;

(d)   interpolating [[a]] the selected image position in the image using the second filter to generate a smooth interpolation output value;

(e)   calculating a different weighting coefficient for the output of each filter by estimating the image a high frequency level at the interpolated selected image position[[s]] and calculating the weighting coefficients based on the estimated image high frequency level; and

(f)   selectively combining the output values from the filters as a function of the weighting coefficients, to generate an interpolation output value for the selected image position of an interpolated output image.

2.   (Canceled).

3.   (Previously presented) The method of claim 1, wherein the weighting

coefficient α for the first filter output is calculated according to the relation:

$$\alpha = \min(1,\ \max(0, (\varphi - T_1)/(T_2 - T_1)))$$

wherein φ is the image high frequency level estimated for the given

interpolation position, T_1 and T_2 are ~~two~~ pre-determined threshold values where

$T_2 > T_1 \geq 0$; and

the weighting coefficient for the second filter output is $(1 - \alpha)$.

4. (Previously presented) The method of claim 1, wherein the interpolation output

value q for the selected image position is according to the relation:

$$q = r*\alpha + s*(1-\alpha)$$

wherein α and $(1-\alpha)$ are the weighting coefficients for the first and

second filters, respectively ($0 \leq \alpha \leq 1$), and r and s are the filter output values from the

first and second filters, respectively.

5. (Original)   The method of claim 1, wherein:

the first filter comprises a polyphase filter; and

the second filter comprises a polyphase filter.

6. (Original)   The method of claim 5, wherein:

the first filter comprises a one dimensional FIR polyphase filter; and

the second filter comprises a one dimensional FIR polyphase filter.

7. (Original)   The method of claim 5, wherein the two polyphase filters have the same length.

8. (Original)   The method of claim 5, wherein each of the polyphase filters comprises a N-tap M-phase polyphase filter.

9. (Original)   The method of claim 8, wherein for arbitrary or variable interpolation ratios, M has a value of 10 or larger.

10. (Original)   The method of claim 8, wherein N can be either an odd or an even number value.

11. (Original)   The method of claim 5, wherein the two filters are low-pass filters, such that the first filter has a sharp frequency transition band and the second filter has a smooth frequency transition band.

12. (Original)   The method of claim 8, wherein:

calculating the weighting coefficient for each of the two filters further includes the steps of: estimating the image high frequency level at the selected image position, and calculating a weighting coefficient for the output of the filter based on the estimated image high frequency level; and

the image high frequency level at the selected image position is estimated

based on the image high frequency components measured at original image pixels

neighboring the selected image position.

13. (Original) The method of claim 12, wherein the image high frequency

component at the original image pixels is measured using a high-pass filtering process.

14. (Original) The method of claim 13, wherein the image high frequency

component at the original image pixels is measured using a high-pass FIR filter.

15. (Previously presented) A method of interpolating image positions in an

original image to produce an interpolated output image, wherein the original image is

represented by digital input pixel data, comprising the steps of:

providing a first filter having a sharp interpolation characteristic;

providing a second filter having a smooth interpolation characteristic;

each of the filters comprises a N –tap M –phase polyphase filter;

interpolating a selected image position in the image using the first filter to

generate a sharp interpolation output value;

interpolating a selected image position in the image using the second filter to

generate a smooth interpolation output value;

calculating a weighting coefficient for the output of each filter by estimating the

image high frequency level at the selected image position based on image high frequency

components measured at original image pixels neighboring the selected image position,

and calculating the weighting coefficients based on the estimated image high frequency

level;

selectively combining the output values from the filters as a function of the

weighting coefficients, to generate an interpolation output value for the selected image

position of an interpolated output image;

wherein the image high frequency component ϕ_i at each of the original image

pixels is measured according to the relation

$$\phi_i = |\, p_i - 0.5 * (p_{i-1} + p_{i+1}) \,|$$

wherein p_i is original image pixel value where image high frequency

component is to be measured, and p_{i-1} and p_{i+1} are original image pixel values of the

neighboring pixels.

16. (Original) The method of claim 15, wherein the image high frequency level

φ at the selected image position is estimated according to the relation:

$$\varphi = \sum_{i=-\frac{N}{2}+1}^{\frac{N}{2}} (0.5 * (f_{-i+1}^{j} + g_{-i+1}^{j}) * \phi_i)$$

wherein ϕ_i, $i = -\dfrac{N}{2} + 1, \cdots, 0, \cdots, \dfrac{N}{2}$ are the image high frequency

components calculated at the original image pixels that are within the filtering range of

interpolation to the selected image position, f_i^{j} and g_i^{j} are filter coefficients of sub-

filters f^{j} and g^{j} for the first filter and the second filter, respectively, and j is the

interpolation phase for the selected image position.

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17. (Original) The method of claim 12, wherein the image high frequency level at the selected image position is estimated based on the image high frequency components calculated at two original image pixels closest to the selected image position.

18. (Previously presented) A method of interpolating image positions in an original image to produce an interpolated output image, wherein the original image is represented by digital input pixel data, comprising the steps of:

 providing a first filter having a sharp interpolation characteristic;

 providing a second filter having a smooth interpolation characteristic;

 each of the filters comprises a N –tap M –phase polyphase filter;

 interpolating a selected image position in the image using the first filter to generate a sharp interpolation output value;

 interpolating a selected image position in the image using the second filter to generate a smooth interpolation output value;

 calculating a weighting coefficient for the output of each filter by estimating the image high frequency level at the selected image position based on image high frequency components measured at original image pixels neighboring the selected image position, and calculating the weighting coefficients based on the estimated image high frequency level;

 selectively combining the output values from the filters as a function of the weighting coefficients, to generate an interpolation output value for the selected image position of an interpolated output image;

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wherein the image high frequency level φ at the selected image position is

estimated according to the relation:

$$\varphi = d_1 * \phi_0 + d_0 * \phi_1$$

wherein ϕ_0 and ϕ_1 are the image high frequency components calculated at

the two closest original image pixels, d_0 and d_1 are the distances between the selected

interpolation position and the two closest original image pixel and the distance between

two neighboring original image pixels is assumed to be 1, such that $d_0 + d_1 = 1$.

19. (Original) The method of claim 12, wherein the image high frequency level at

the selected image position is estimated based on the image high frequency component

measured at original image pixels that are within the filtering range of interpolation to the

selected image position.

20. (Previously presented) A method of interpolating image positions in an

original image to produce an interpolated output image, wherein the original image is

represented by digital input pixel data, comprising the steps of:

providing a first filter having a sharp interpolation characteristic;

providing a second filter having a smooth interpolation characteristic;

each of the filters comprises a N–tap M–phase polyphase filter;

interpolating a selected image position in the image using the first filter to

generate a sharp interpolation output value;

interpolating a selected image position in the image using the second filter to

generate a smooth interpolation output value;

calculating a weighting coefficient for the output of each filter by estimating the

image high frequency level at the selected image position based on image high frequency

components measured at original image pixels neighboring the selected image position,

and calculating the weighting coefficients based on the estimated image high frequency

level;

selectively combining the output values from the filters as a function of the

weighting coefficients, to generate an interpolation output value for the selected image

position of an interpolated output image; and

wherein the image high frequency level φ at the selected image position is

estimated according to the relation:

$$\varphi = \sum_{i=-\frac{N}{2}+1}^{\frac{N}{2}} (0.5 * (f_{-i+1}^{j} + g_{-i+1}^{j}) * \phi_i)$$

wherein ϕ_i, $i = -\dfrac{N}{2}+1, \cdots, 0, \cdots, \dfrac{N}{2}$ are the image high frequency

components calculated at the original image pixels that are within the filtering range of

interpolation to the selected image position, f_i^{j} and g_i^{j} are the filter coefficients of sub-

filters f^{j} and g^{j} for the first filter and the second filter, respectively, and j is the

interpolation phase for the selected image position.

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21. (Currently amended) An interpolation system that interpolates image positions in an original image to produce an interpolated output image, wherein the original image is represented by digital input pixel data, comprising:

(a)   a first filter having a sharp interpolation characteristic, the first filter interpolating a selected image position in the image to generate a sharp interpolation output value;

(b)   a second filter having a smooth interpolation characteristic, the second filter interpolating the selected image position in the image to generate a smooth interpolation output value;

(c)   a controller that calculates a weighting coefficient for the output of each filter by estimating ~~the image~~ a high frequency level at the interpolated selected image position, and calculating a weighting coefficient for the output of the filter based on the estimated image high frequency level; and

(d)   a combiner that selectively combines the output values from the filters as a function of the weighting coefficients, to generate an interpolation output value for the selected image position of an interpolated output image.

22.   (Canceled).

23. (Previously presented) The system of claim 21, wherein the controller calculates the weighting coefficient α for the first filter output according to the relation:

$$\alpha = \min(1, \ \max(0, (\varphi - T_1)/(T_2 - T_1)))$$

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wherein φ is the image high frequency level estimated for the given interpolation position, T_1 and T_2 are two pre-determined threshold values where $T_2 > T_1 \geq 0$, whereby that the weighting coefficient for the second filter output is $(1 - \alpha)$.

24. (Previously presented) The system of claim 21, wherein the combiner determines the interpolation output value q for the selected image position according to the relation:

$$q = r*\alpha + s*(1-\alpha)$$

wherein α and $(1-\alpha)$ are the weighting coefficients for the first and second filters, respectively ($0 \leq \alpha \leq 1$), and r and s are the filter output values from the first and second filters, respectively.

25. (Original) The system of claim 21, wherein:

the first filter comprises a polyphase filter; and

the second filter comprises a polyphase filter.

26. (Original) The system of claim 25, wherein:

the first filter comprises a one dimensional FIR polyphase filter; and

the second filter comprises a one dimensional FIR polyphase filter.

27. (Original) The system of claim 25, wherein the two polyphase filters have the same length.

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28. (Original) The system of claim 25, wherein each of the polyphase filters comprises a N -tap M -phase polyphase filter.

29. (Original) The system of claim 28, wherein for arbitrary or variable interpolation ratios, M has a value of 10 or larger.

30. (Original) The system of claim 28, wherein N can be either an odd or an even number value.

31. (Original) The system of claim 25, wherein each of the two filters comprises a low-pass filter, such that the first filter has a sharp frequency transition band and the second filter has a smooth frequency transition band.

32. (Original) The system of claim 28, wherein:

the controller calculates the weighting coefficient for each of the two filters by estimating the image high frequency level at the selected image position, and calculating a weighting coefficient for the output of the filter based on the estimated image high frequency level, such that the image high frequency level at the selected image position is estimated based on the image high frequency components measured at original image pixels neighboring the selected image position.

33. (Original) The system of claim 32, wherein the image high frequency

component at the original image pixels is measured using a high-pass filtering process.

34. (Original) The system of claim 33, wherein the image high frequency

component at the original image pixels is measured using a high-pass FIR filter.

35. (Currently amended) An interpolation system that interpolates image positions

in an original image to produce an interpolated output image, wherein the original image

is represented by digital input pixel data, comprising:

a first filter having a sharp interpolation characteristic, the first filter interpolating

a selected image position in the image to generate a sharp interpolation output value;

a second filter having a smooth interpolation characteristic, the second filter

interpolating the selected image position in the image to generate a smooth interpolation

output value;

wherein each of the first and second filters comprises a polyphase filter, and each

of the polyphase filters comprises a N–tap M phase polyphase filter;

a controller that calculates a weighting coefficient for the output of each filter by

estimating the image high frequency level at the selected image position, and calculating

a weighting coefficient for the output of the filter based on the estimated image high

frequency level such that the image high frequency level at the selected image position is

estimated based on image high frequency components measured using a high-pass

filtering process at original image pixels neighboring the selected image position; and

a combiner that selectively combines the output values from the filters as a

function of the weighting coefficients, to generate an interpolation output value for the

selected image position of an interpolated output image;

wherein the image high frequency component ϕ_i at each of the original image

pixels is measured according to the relation:

$$\phi_i = \mid p_i - 0.5 * (p_{i-1} + p_{i+1}) \mid$$

wherein p_i is original image pixel value where image high frequency

component is to be measured, and p_{i-1} and p_{i+1} are values of its neighboring pixels.

36. (Original) The system of claim 35, wherein the image high frequency level φ

at the selected image position is estimated according to the relation:

$$\varphi = \sum_{i=-\frac{N}{2}+1}^{\frac{N}{2}} (0.5 * (f_{-i+1}^j + g_{-i+1}^j) * \phi_i)$$

wherein ϕ_i, $i = -\dfrac{N}{2} + 1, \cdots, 0, \cdots, \dfrac{N}{2}$ are the image high frequency

components calculated at the original image pixels that are within the filtering range of

interpolation to the selected image position, f_i^j and g_i^j are filter coefficients of sub-

filters f^j and g^j for the first filter and the second filter, respectively, and j is the

interpolation phase for the selected image position.

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37. (Original) The system of claim 32, wherein the image high frequency level at

the selected image position is estimated based on the image high frequency components

calculated at two original image pixels closest to the selected image position.

38. (Currently amended) An interpolation system that interpolates image positions

in an original image to produce an interpolated output image, wherein the original image

is represented by digital input pixel data, comprising:

a first filter having a sharp interpolation characteristic, the first filter interpolating

a selected image position in the image to generate a sharp interpolation output value;

a second filter having a smooth interpolation characteristic, the second filter

interpolating the selected image position in the image to generate a smooth interpolation

output value;

wherein each of the first and second filters comprises a polyphase filter, and each

of the polyphase filters comprises a N –tap M phase polyphase filter;

a controller that calculates a weighting coefficient for the output of each filter by

estimating the image high frequency level at the selected image position, and calculating

a weighting coefficient for the output of the filter based on the estimated image high

frequency level such that the image high frequency level at the selected image position is

estimated based on image high frequency components measured at original image pixels

closest to the selected image position;

a combiner that selectively combines the output values from the filters as a

function of the weighting coefficients, to generate an interpolation output value for the

selected image position of an interpolated output image;

wherein the image high frequency level φ at the selected image position is

estimated according to the relation:

$$\varphi = d_1 * \phi_0 + d_0 * \phi_1$$

wherein ϕ_0 and ϕ_1 are the image high frequency components calculated at

the two closest original image pixels, d_0 and d_1 are the distances between the selected

interpolation position and the two closest original image pixels, the distance between two

neighboring original image pixels is assumed to be 1, such that $d_0 + d_1 = 1$.

39. (Original) The system of claim 32, wherein the image high frequency level at

the selected image position is estimated based on the image high frequency component

measured at original image pixels that are within the filtering range of interpolation to the

selected image position.

40. (Currently amended) An interpolation system that interpolates image positions

in an original image to produce an interpolated output image, wherein the original image

is represented by digital input pixel data, comprising:

a first filter having a sharp interpolation characteristic, the first filter interpolating

a selected image position in the image to generate a sharp interpolation output value;

a second filter having a smooth interpolation characteristic, the second filter

interpolating the selected image position in the image to generate a smooth interpolation

output value;

<u>wherein each of the first and second filters comprises a polyphase filter, and each</u>

of the polyphase filters comprises a N–tap M phase polyphase filter;

a controller that calculates a weighting coefficient for the output of each filter by

estimating the image high frequency level at the selected image position, and calculating

a weighting coefficient for the output of the filter based on the estimated image high

frequency level such that the image high frequency level at the selected image position is

estimated based on image high frequency components measured at original image pixels

neighboring the selected image position;

a combiner that selectively combines the output values from the filters as a

function of the weighting coefficients, to generate an interpolation output value for the

selected image position of an interpolated output image;

wherein the image high frequency level φ at the selected image position is

estimated according to the relation:

$$\varphi = \sum_{i=-\frac{N}{2}+1}^{\frac{N}{2}} (0.5 * (f_{-i+1}^{j} + g_{-i+1}^{j}) * \phi_i)$$

wherein ϕ_i, $i = -\dfrac{N}{2}+1, \cdots, 0, \cdots, \dfrac{N}{2}$ are the image high frequency

components calculated at the original image pixels that are within the filtering range of

interpolation to the selected image position, f_i^{j} and g_i^{j} are the filter coefficients of sub-

filters f^{j} and g^{j} for the first filter and the second filter, respectively, and j is the

interpolation phase for the selected image position.